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[The following are translations of selected articles in the Russian-language monthly journal AVIATSIYA I KOSMONAVTIKA published in Moscow. Refer to the table of contents for a listing of any articles not translated.]

Air Forces Education Deputy Chief on Problems, Outlook

92UM0899A Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 92 (signed to press 23 Dec 91) pp 2-3

[Article by Air Forces Higher Educational Institutions Deputy Chief Military Pilot 1st Class Major-General Aviation Ya. Yanakov under the rubric "Military Reform and the Higher Educational Institutions": "From the Retro to the Modern"]

[Text] *Paramount attention in the developed nations is devoted to training professionals and offering them opportunities to reveal themselves as individuals. They understand in excellent fashion there that the competent specialist is the chief link in the chain that, by pulling it, they can get the firm, the sector and even the whole nation out of any crisis.*

Air Forces Higher Educational Institutions Deputy Chief Military Pilot 1st Class Major-General Aviation Ya. Yanakov relates the opportunities and prospects at the disposal of the current system of aviation higher educational institutions to ensure the high combat readiness of the Air Forces.

The events of August 1991 have accelerated the process of radical changes in the country's armed forces. They have also had a direct effect on the aviation training establishments—the factor on which the future of our Air Forces largely depends. Real opportunities have finally appeared to set about in earnest the profound reformation of the system of higher educational institutions, including social and professional protections for the fliers at the same time.

There is unfortunately not yet complete clarity in resolving the fate of the system of higher educational institutions, as for the whole union army. But attempts are being undertaken to transfer the aviation educational institutions to other agencies, cut back or consolidate them and reform the system of administration for the higher educational institutions, and the problem of accommodating those institutions on the territory of a number of the former union republics that have declared their independence has arisen.

It is gratifying to note that common sense is returning to us, albeit slowly. It is becoming obvious that no one will survive with today's state of the economy, at least during the so-called transitional period, and it is necessary to refrain from ripping the educational institutions into national and departmental pieces. The professional training of the fliers is a kind of realm of application of the fine technologies, requiring large material expenditures. The need for the centralization of such work is even more obvious with a regard for the necessity of training aviation cadres for more than a hundred fields and specializations, including pilots and navigators for the various branches of aviation, in the face of relatively low requirements for them for each branch of the armed forces.

The accepted conceptual framework for the development of the Air Forces higher educational institutions to the year 2000 envisages a transition to the training of flight cadres according to the system of "boarding-school (ShI)—initial flight training—flight school—aviation training center (UATs) for cross-training personnel for a combat aircraft—line unit." The realization of this program requires the corresponding capital investments and logistical support, which are lacking today. And the consequences are already being felt.

Only two of the planned eight boarding schools have been able to be opened—in Yeysk and Barnaul—and that with the greatest difficulty. The Barnaul ShI, however, is on the brink of closing due to a lack of attention from the kray authorities, who were entrusted with financing it. The other school is also experiencing quite a few difficulties. The local authorities are not rushing to open new ShIs, despite the decisions made earlier by the higher offices, due to their own meager budgets.

A question arises here—if the Ministry of Defense does not have the necessary financial resources for these purposes, shouldn't corrections be made in the concepts that were adopted earlier for the training of flight cadres? Otherwise the very idea takes on a fallacious nature straightaway. And here is why. Youth are being accepted into the ShIs who are not yet fully formed either physically or psychologically. They are in need of the creation of domestic comfort, paternal relations and attention for all-round development. Can you really cultivate in the youth a desire to devote their lives to the army to the full extent by offering them bunk beds, military discipline and the like instead?

Matters are no better from this point of view with those entering the VVAULs either. The existing techniques of professional selection for the flight higher educational institutions make it possible to forecast with a likelihood approaching the unit value what sort of pilot the cadet under training will become. But the poor motivation of the youth for entry into the military schools, including the flight schools, does not permit this to be realized—there is no contingent for selection, there is no one to choose from. The number of aspirants for each place does not exceed 1.1—1.2 after passing of the exams. The number of entrants from among them with the first group of professional selection (with enormous allowances for general educational training) does not exceed 25 percent. We are left with the fact that we must teach them, knowing in advance that the quality of a certain portion of the graduates will be poor. And flight accidents, after all, are the prerogative of poor pilots... The country, by economizing with people, later bears enormous material and moral costs.

Today's youth has begun to look well into life's questions. They are not now tempted by simple summons

and slogans alone. Concrete guarantees are needed of the dignified status of the officer in society. And until the questions of housing, social protections for the flier and his comfortable existence when retiring are resolved, the tight knot of higher educational problems with people will not be untied, aggravating the already grave situation of the Air Forces.

Today's higher educational system has also not yet exhausted its reserves, as testified to by the adoption of a series of innovations in the training of pilots for frontal aviation. They include a transition from the training principle of "trainer aircraft—basic training and combat aircraft—base training at the school" to the system of "trainer aircraft—initial and base training at the school, combat aircraft (UATs)—retraining and achievement of a level of training obtained on a trainer craft." Comprehensive programs for the training of pilots, linking their training at the VVAUL and UATs with the operations of the line units, were also being adopted at the same time.

That approach promised a significant improvement in the quality of training of the graduates under certain conditions. Experience has shown that there was not a single flight accident through the fault of trainees over the period from 1988 through 1991 on combat aircraft at the UATs. A radical turnaround, however, did not occur. The centers are not yet performing their chief mission—they are not able to training the young pilots up to the level of combat training required in the line units, since it is not supported in a material sense. A minimum of 110-120 hours of flying time are required for the full retraining of a young pilot on a combat aircraft, but so many trainees have been assigned to the squadrons that they are able to get only 60-80 hours. By effectively instituting a fifth year of training for the graduates, we have not moved far from the the level of their proficiency at the schools with four-year training on trainers and combat aircraft. Cut back the number of trainees in the squadron from 25 to 15, and the problem can be solved—the commanders of the line units would be freed from finishing off the training of newly arrived young pilots, which often lasts two-three years.

One also cannot leave aside the problem of the flight-instruction staff. It is namely against them that many sharp features have been appearing in the press of late. And there is nothing here for us to boast about, except the fact that the pay has finally been equalized for skills categories for instructors and line pilots.

But the instructor, being the principal training and indoctrination individual at the flight school and the UATs, continues to be be unfairly passed over and diminished compared to the line pilots. The time has long since come to get this individual out from under the stamp of the general concept of "instructor" figured for all cases of life in the catalog of posts of the General Staff, and give him special status.

Today's structure of training units of the VVAUL and UATs was worked out at one time in such a way that 50 percent is comprised of those who are called upon directly to teach (instructor pilots), and 50 percent were to monitor and organize their work. The immediate level of training for the trainers, on whom the quality of the proficiency of the graduates depends, is significantly lower than most of the detachment of check pilots. The situation is paradoxical, but that is our reality as engendered by a system that has demonstrated its insolvency but has not yet been conclusively broken up.

Instructors continue to be trained from among the young graduate pilots starting virtually from zero, bringing them to the necessary level of proficiency in four to five years. And later, during the period of attainment of professional maturity, it is not advantageous for the newly fledged pedagogues to remain in the post of instructor; otherwise, there will be no prospects for them.

No small amount of funding goes to maintain the check pilots. If each of them gets flying time of 50 hours for personal improvement on a trainer, then that line item alone costs the state 50,000 rubles a year. This figure exceeds 400,000 on a combat aircraft.

We should immediately, in my opinion, set about the re-organization of the structure of the training units and squadrons. The funds that are freed up thereby, through 20-30-percent reductions in the numbers of supervisory flight personnel (from the flight commander on up), could be used for an annual pay supplement to instructors for the final results of training of the cadets and trainees, on a scale of no less than 50 percent of their annual income.

Changes in the structure of the training subunits and pay for instructors are being proposed for the future by which they would not feel themselves to be morally and materially diminished and would not change their profession for any other one, thereby ensuring the stability of personnel in the training units. Matters would only gain if the instructor has a wealth of experience in the training and indoctrination of cadets and trainees, and is professionally prepared to the utmost. Such a specialist would not need check pilots, since he is able to resolve the tasks of training and bear responsibility for its ultimate results independently. The supervisory personnel are needed only for organizational activity and partial monitoring, not total as today.

The sharp reformation of a system of personnel training that has taken shape over many long years, however, is also fraught with dangerous consequences. A degradation of the technology of training for pilots and the methodological preparation of the instructors has transpired in recent decades. Much of what was gained in the 1930s-1950s has been lost. I see the cause of that in the transition at the VVAUL to a technocratic, sudorific system of training flight personnel in the 1970s and beginning of the 1980s, when an expansion of the Air Forces was underway and more and more pilots and increases in their flying time were needed. The number of squadrons in regiments was increased to six in the

chase after gross indicators, and they began flying two shifts six days a week, operating virtually around the clock at the principal and camp airfields.

The supervisory personnel were not able to handle methodological work with subordinates during that period. They only had time to organize flight shifts and supervise the flights. It was frequently not the best graduates who were left as instructors either, but rather those who had not been able to master a combat aircraft. The training regiments were supplemented with DOSAAF graduates who did not even have higher education. The rapid turnover of generations of instructors was occurring—the "elders" were departing—under conditions of insufficient attention toward the professional preparation of the permanent staff.

The break in the continuity of experience in training and indoctrination later led to a decline in the professional level of the supervisory personnel of the squadrons and regiments through those newly assigned to their posts. A competent supervisor of the regimental and academy flight has currently become "scarce," and the problem of selecting and placing personnel and seeking out ways of getting the system of training for fliers out of the crisis situation has arisen for the administration of the higher educational institutions.

The problems of the engineering and technical personnel and those in the support units continue to trouble us. The service burdens on them in the higher educational system are higher than in the line units, since the rate of flights here is two or three times greater. Aircraft technicians are especially lacking. One criterion of their work at a VVAUL and UATs is flying time for an aircraft. The extant system of leveling in pay, however, puts the negligent and those who are working without pause on the same level. The necessity has thus become acute at the higher educational institutions of instituting pay for flying time supported—then not only individuals, but all of the aircraft technicians would strive to maintain their craft in good working order. Additional funds could be found here through a re-organization of the structure of the IAS [aviation engineering service] (it is analogous to that of the line units today) and cutbacks in superfluous organizational levels. The restructuring of the IAS should be aimed at ensuring the maximum flying time, the efficient utilization of the aircraft inventory and support equipment—if they are flying 12 shifts a week at the airfield, the structure of the subunits should support that operating regimen.

The higher educational institutions are operating under even greater conditions of manpower shortages among the technical personnel than the line units. It exceeds 30 percent in individual subunits. The involvement of conscript servicemen in technical duties and the paired-shift system of maintenance—where one technician simultaneously supports the flights of two aircraft and works on both—have moreover long been practiced now. Why, in that case, not pay him for his overtime work—he is, after all, in concrete production "at his post." By ignoring that element we are directly denigrating the rights of the person—even if he is just a serviceman, whose work is not the most highly paid in society today—so as to have an abnormal workday.

It would seem that the leadership of the Air Forces higher educational institutions, of which I as deputy chief am a part, is called upon to resolve all of the issues raised. The readers, however, will have to be disappointed. All problems, and especially cadre ones, that are connected with material and financial expenditures are resolved in strictly centralized fashion under the military administrative system that took shape over many long years. We make a detailed study of all urgent issues and head upward with proposals. We have, however, unfortunately not always found the proper understanding and support in the upper echelons of the Ministry of Defense.

The military-scientific potential that exists in the army, after all, would seem to be able to provide a comprehensive and objective analysis of the state of affairs and protect us against mistakes. Many sensible suggestions are also coming in from the local areas. But subjective considerations and assessments from above, far from the optimal ones, for some reason continue to gain the upper hand. New instructions from above stipulate increasing acceptance into the flight schools even now, when there is a clear surplus of flight personnel and it is not clear where to "settle" the graduates.

The training of engineering and technical personnel has taken on a monstrous nature. There are clearly not enough officers with technical education in the units, and there is a clear surplus of those with engineer training. That is why the latter have to be placed in technical posts, where they lose their skills in two or three years. The opinion is still widespread among the population that an engineer is a highly educated and intelligent person who carries with him all that is new and progressive. The state invests enormous funding in his education, and suddenly in aviation, where the latest achievements of science and technology are concentrated, there is such neglect of the specialists!

The under- and over-staffing of personnel in various specialties agitates combat training in the formations and units, has a negative effect on the fates of people and creates excess social tension. And how many young officers, having become disillusioned with their chosen profession, leave the armed forces in the initial stages of their service?...

Many of the drawbacks could be eliminated if the higher educational institutions were to convert to the training of specialists according to orders from the directorates and services of the main staffs of the branches of the armed forces and other agencies. Then there would not be such absurdities as where certain specialists are in short supply and others have "bred" in such quantity that there is nowhere to put them and you cannot find anyone who will bear responsibility.

Determination of the requirements for specialists for the long run (in accordance with a training cycle of a minimum of four or five years ahead) and the setting of the quantity of them for acceptance into the higher educational institutions is a far from simple matter. A responsible and well-informed body is needed that has in its arsenal special techniques and algorithms for calculation and powerful computer equipment.

Unfortunately, until recently there were no dedicated scientific centers or serious analytical groups in the armed forces forecasting cadre policy. Many decisions, even today, are not based on economic computations, while it is namely from economic illiteracy that our chief misfortunes and errors come. The necessity of economic training for commanders is clearly knocking at our door.

I would like to express in conclusion my alarm on the score of the flight higher educational institutions, which are at the lowest level of sufficiency and amenities among the educational establishments of the Ministry of Defense. They could fall under the hammer first of all during a period of re-organization and cutbacks. The leadership of the educational establishments, for their part, have submitted reasoned proposals for such a reform, taking into account the preservation of the educational physical plant and the solution of the problem of a surplus of flight personnel on the basis of an optimization of their training and reduction of the material expenditures for it. The creation of a teaching complex for the flight training of cadets that would embody modern approaches to the training of flight crews with a regard for the prospects for the development of domestic aviation will play a large role therein.

Officer Responds to Criticism of Air Forces Flight-Safety Service

92UM0899B Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 92 (signed to press 23 Dec 91) pp 4-6

[Article by USSR Honored Military Navigator, Candidate of Military Sciences Colonel (Reserve) V. Dudin under the rubric "Combat Training and Flight Safety": "Through a Mass of Stereotypes"]

[Text] *Glasnost continues to uncover an interminable stream of problems that used to be kept silent in the life of our armed forces. Assessments of the radical transformations that are occurring in the army have begun to appear on the pages of various—and sometimes opposite in thrust—press publications. It is gratifying that the representatives of the Air Forces have not remained far from this rostrum of glasnost as well. The unfeigned interest of fliers was evoked, for example, by the reflections of the deputy commander of an aviation regiment, Lieutenant-Colonel V. Vysotskiy, on the score of the problems of combat training for military pilots as set forth by him in an interview with a correspondent from KOMSOMOLSKAYA PRAVDA (7 Aug 91) and in the journal AVIATSIYA I KOSMONAVTIKA (1991, No. 11). Readers probably noted that a number of the critical observations of V. Vysotskiy were addressed to the Aviation Flight Safety Service [SBP] of the Ministry of Defense, christening it an "inexhaustible trough." We will, at any rate, leave that judgment to the conscience of the author. And for the sake of objectivity we give the floor to a person who has worked at that "trough" for a long time—USSR Honored Military Navigator and Candidate of Military Sciences Colonel (Reserve) V. Dudin.*

What haven't we undertaken in the not-so-distant past in order to increase flight safety in military aviation—we have declared it a matter of state importance, we were developing voluminous plans at one sitting, right up to comprehensive programs, figured right through the end of the century, requirements for the observance of the flight rules and regulations were tightened up to the utmost (and, in fact, toward those who permitted the slightest misstep), we removed pilots from flight operations for one precursor condition to an accident committed by the whims of chance... But the accident rate—although a trend toward decline has been noted in recent years—"remains at an intolerably high level" anyway.

It is entirely natural that the unsatisfactory state of affairs in this realm of aviation practice is the principal impetus evoking the activeness of fliers in the search for ways leading to a reduction in the accident rate. One frequently has to encounter instances of the incorrect treatment of this problem, however, and its consideration not only outside of any connection with the components of flight safety, but often apart from the realities of the modern day altogether.

That is how it turns out with Lieutenant-Colonel V. Vysotskiy in particular, who feels that the problem of flight safety will be solved in and of itself with the appearance in our aviation of the Master (it is namely that way, Bulgakov style, with the capital letter, in the collective form, that it is given in the aforementioned features). Safety measures, in his opinion, would simultaneously become unnecessary when implementing flights, and they would bid a fond farewell to the existing organizational structures that are on guard for the irreproachable fulfillment of the requirements for increasing flight safety, whose personnel are supposedly concerned only with preserving their own "trough" (it must be understood—the accident rate?!)

But what, permit me to ask, are the quick-tempered assertions of V. Vysotskiy worth on the universal suppression of the personality of the Master in our aviation in the course of the whole post-October period with just one mention of the names of Gromov, Kokkinaki, Cherevychnyy, Pokryashkin, Kozhedub and Molodchiy? Hundreds of such examples could be cited. The extolling of the extra-professional in aviation, in my opinion, is too abstract, since it is not only lieutenants that perish in

air accidents, but also the most well-known test pilots, professional aerobatic pilots, chief pilots with world names. Aviation accidents have their own harsh rules—no reputations exist for them. The safety measures for each concrete flight are thus not somebody's whim, but are requirements written in the blood of past tragedies and are aimed at eliminating them in the present and in the future.

Recall, for example, the well-known case of the collision of two aircraft in the squadron of Italian Air Force aerobatic pilots during an air show in Germany, when after several striking maneuvers they were performing one of the most risky elements—two groups of aircraft passing on intersecting courses with divergence at the minimally possible lateral distance. The pilots had demonstrated this maneuver brilliantly dozens of times, and they had always been accompanied by success. A tragedy occurred this time, however, and moreover in front of several thousand spectators, dozens of whom were maimed or killed by aircraft fragments falling on them. And after all, safety measures known to the entire aviation world for the performance of such types of maneuvers could have averted this catastrophe entirely—the vertical separation of the crews and their maintenance of the assigned intervals between aircraft in the group.

It should be acknowledged, of course, that a lack of objectivity in the evaluation of the state of affairs in ensuring flight safety can not only be traced in the statements of the fliers at the regimental level, but can also be clearly discerned in individual official documents that have come to light as the result of performing checks of the troops by representatives of Air Forces Combat Training and the commanding generals of aviation formations, which sometimes transfer directive requirements automatically into the rank of drawbacks in the personnel of the units and formations being checked, moreover not undertaking even the slightest attempt to make an objective evaluation of its capability to realize those same requirements.

I am not talking about this by accident. The point is that the process of combat training for the majority of the aviation regiments today transpires under conditions of a clearly discerned "split"—the strict and full-fledged requirements of the standard documents for the organization and performance of flights on the one hand, and the trimmed-back material support for flight training (one need also not forget the expenditures for the infrastructure for the everyday vital activity of the fliers and the members of their families as well) on the other. The poor (and sometimes simply wretched) level of sophistication of the physical plant for training, the constant shortages of hardware and flight-support equipment, the irregular rhythms of deliveries of fuel and training ordnance—this sad picture can unfortunately be observed in many aviation garrisons today.

So then it turns out that the clear lack of conformity between "meticulous regulation" and "non-meticulous support" puts the pilots, and to an even larger extent their commanders who are organizing the flights, into a position knowingly doomed to various types of violations: as soon as he has taken up the compilation of the flight schedule or occupied the position of flight operations officer—and the more so the cockpit of an aircraft or helicopter—he will be violating something without fail.

There would at the same time seem to be no need to dramatize the state of affairs with the accident rate in our military aviation. If we approach the evaluation of it from other than a dependent standpoint (without setting oneself the aim of blaming everyone but oneself for existing and past difficulties), with an understanding of the essence of the current period on the development of the armed forces and an awareness of the place and role of one's own regiment and squadron in the cause of raising their combat readiness, after all, then it could turn out that it is operating in rhythmic fashion, calmly or, as they say in aviation, fine.

Matters are namely that way in the formation commanded by Major-General Aviation V. Zhdanov (a past officer of the Flight Safety Service, by the way). The fliers in the units subordinate to him have been flying without crashes and accidents for a span of several years now, the result of energetic work by the supervisory personnel of the regiments and divisions to prevent flight accidents. And there are no few such examples.

And one must nonetheless look with regret at the exceedingly simplistic understanding of the problems connected with ensuring flight safety that is widespread among those individuals responsible for the state of affairs in aviation. It is having a negative effect both on the results of the investigation of specific flight accidents, and on the evaluation of the accident rate for the Air Forces overall.

Sometime the crashed aircraft is still smoking and things are already completely clear to some official—both who is guilty of what happened, and what should be said in his investigatory document. It is good if the representatives of the services in charge of issues of flight safety have at their disposal irrefutable proof making it possible to establish clearly the true causes of an accident or crash. Otherwise they have to push through the fencing of contradictory versions of the flight accident as defined by the representatives of the various aviation services making up the commission, complain once again of the limited capabilities of the on-board and ground objective-monitoring equipment and clash head-on with the obstinacy, ambitions and, frequently, difficult-to-surmount obstacles on the path of the investigation being caused by the senior aviation officers of various ranks.

How can one fail to remember here a case of the investigation of the reasons for the crash of an Su-27 (the journal has already related it), where research conducted with a jeweler's precision, through the miracle of the

intact control valve of the aircraft landing gear, made it possible to establish that the primary cause of the spontaneous emergence of one of the main landing-gear struts during aerobatic maneuvering was not the "imprecision of the pilot in operating the controls in the cockpit," as some members of the commission heartily tried to prove, but rather the poor quality of the design refinements made by the industry to install a new control mechanism for the braking chute, which restricted (literally by a few millimeters) the required range of motion of the lever for switching the landing-gear valve.

The practice of investigating this type of flight accident proves convincingly that work on reducing the accident rate in aviation should be aimed at eliminating (or at least reducing to the minimum possible level) the effects on flight safety of all of the host (and not certain ones taken separately) of negative factors that are characteristic of the functioning of the elements of the "pilot—aircraft—environment" aviation system.

I would like to note that the concept of "flight safety" itself is understood in different ways at different levels: it is in reality a property of the aviation system for representatives of the Air Forces administrative apparatus; it is the actual edge between the plans for raising combat readiness and the restricted opportunities for the unswerving fulfillment of all the requirements of documents regulating accident-free flight operations for the commands organizing and supervising the flights; for the pilot it is reduced to a desire to avoid a serious flight accident (one and only) in his flight practice that would inevitably "bury" his further flight career, thereby making timely payment of the person not only for his own professional "imperfections," but for many faults as well.

Fliers should thus debate flight safety and make practical recommendations for maintaining it at a high level (thus far, unfortunately, only general calls are being sounded) in a differentiated fashion for each of the enumerated levels, and not repeat the already bitter-sounding set of one and the same terms and concepts usable to an equal extent by the deputies of the commander-in-chief and flight commanders.

I would like to dwell on something else in continuing the topic of the discussion on problems connected with flight safety that was started by Lieutenant-Colonel V. Vysotskiy. It is gratifying that military reform is gaining pace in our armed forces, sometimes beating its way through a mass of stereotypes of the past that have outlived themselves. It has also touched on the bodies of flight safety—by decision of the minister of defense its lead organization, the Aviation SBP of the USSR Ministry of Defense, was removed from the structure of the Air Forces at the end of last year and is now subordinate (as was its predecessor, the Central Inspectorate of Flight Safety of the USSR Armed Forces) directly to him.

It must be noted that this positive step was pursuing the aim of creating not only suitable conditions for conducting objective investigations of all flight accidents without exception, in the course of which the "interests" of various ministries and agencies inevitably used to clash, but also to obtain thereby the opportunity for a fundamental evaluation of the state of affairs with the accident rate in the aviation of the armed forces, as it was at the end of the 1970s and beginning of the 1980s.

What are the principal tasks facing the flight-safety bodies that could be singled out in connection with the measure that has been adopted?

They are, first and foremost, coordination of the activity of the various directorates and services of all branches of the armed forces (with an immediate relation to the selection of the youth to the flight higher educational institutions, the staffing of the line and other aviation units with personnel, their technical sophistication and, of course, the combat readiness of the fliers) in concentrating the principal efforts in their work on raising the level of flight safety. It is time to put an end once and for all to the user attitude toward this acute problem and the almost unconcealable indifferent attitude of many commanders to the needs and aspirations (and not only of a social nature) of the aviation specialists of all categories. Whatever they may say there, despite the multitude of factors determining the outcome of a flight, all of them are by their specific nature wholly subordinate to the effects of specific officials, and there should be exactingness toward them.

It is being proposed that preventive work to reduce the level of accidents in aviation henceforth be conducted not on a general plane, as before, but that it be directed toward the eradication of the chief causes of most flight accidents. The principal plans of measures, the requirements of standard documents and scientific research will also be directed toward this, and no small amount of funding allocated. A substantial rise in safety in the performance of takeoffs and landings, aerobatic maneuvers and weapons delivery is that concrete aim that we, alas, have not been able to achieve in the past and that the bodies of flight safety have placed before themselves this year.

These are difficult tasks, you will agree, but entirely attainable if we approach their resolution in an exclusively professional manner, listening keenly to the opinions of all categories of fliers and comparing their capabilities with the realities of the current day.

And in conclusion. Judgments by some fliers that the representatives of the central flight-safety bodies are rabid opponents of flight mastery and, at the same time, have an "inexhaustible trough" are just as wrong as they are incorrect. If the question is posed that way, what can we say then about the analogous services of the developed aviation countries, where they were created much earlier than ours, and are greatly outstripping us today in improving their own standard structures?

And another thing. I would like to invite Lieutenant-Colonel V. Vysotskiy, on behalf of the specialists of the SBP, to work a little at the "trough," and moreover not only with the aim of exchanging opinions, but also to "check it out" on joint trips (150-180 days a year) to the "holes"; let him become convinced how to "fight" with ambitious commanders, "vie" with the representatives of the defense industry and hear, not just once and not just twice a month, the widows and the comrades of the dead pilots... The inspector pilots themselves, meanwhile, also have to fly themselves, maintaining their mastery. Whether it is written with a capital or a small letter.

Superficial Investigation of Flight Accidents Decried

92UM0899C Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 92 (signed to press 23 Dec 91) pp 6-7

[Article by Candidate of Medical Sciences Colonel of the Medical Service A. Fedoruk under the rubric "Flight Safety: Experience, Analysis, Problems": "Who Needs the 'Shopworn' Phrases?"]

[Text] Every flier knows very well what flight accidents (LP) lead to. The loss of expensive, sometimes unique hardware, and in the most unfavorable variation people as well, who are entirely irreplaceable for relatives and loved ones, are the most grave but, unfortunately, far from the only consequences. They also include a prolonged disruption of the rhythm of flight operations in the subunit and unit overall and the loss of the levels of combat readiness that had been attained for a considerable time, as well as a disruption of the fates of officers and the members of their families. And for virtually all clarifications of the circumstances and causes of what happened, two intertwined ideas arise in the consciousness—the absurd and illogical nature of what happened, which could have been averted entirely with more correct actions by officials (both the flight and the ground personnel), and just why, once again, the bitter experience of prior analogous situations proved to be unassimilated once again. Fundamental and objective answers to these questions, after all, constitute the principal task of the commission investigating the LP and are, simultaneously, a criterion of the quality of its operation.

How, for example, is the undiminished repetitiveness of flight accidents on one of the recent-generation maneuvering aircraft of frontal aviation—the MiG-29—being perceived? This type of aircraft, distinguished to advantage from its predecessor by considerably enhanced reliability, especially of the power plant (there have been literally a couple of failures of them in line units over several years of operation), is at the same time systematically supplementing its "baggage" of the accident rate with instances that are exceedingly similar to one another. They are all connected with specific features of stability and controllability at certain speeds and angles of attack, at which a reverse roll reaction of the control surfaces is manifested in the control channel. These events are multifactored, *i.e.* their origin is causes that are operating in each of the elements of the "pilot—aircraft—environment" system. But that is just the point, that the very first losses of these aircraft, being piloted by exceedingly experienced pilots, were relegated to the so-called "other causes" by the corresponding investigating commissions, in which there was no clear focus on the drawbacks, and more precisely the negative specific features of each of the enumerated elements. As if private and concrete drawbacks had not taken shape among the pilot, the aircraft and the environment, and something intangible and different had happened... And then this "different thing" then went on from one accident situation to the next, now called either drawbacks in the organization of flights, now errors in piloting the hardware, and now the lack of discipline of the pilot (especially when he could say nothing in his own justification after an accident). But the essence of all of these flight accidents is one and the same thing.

Yes, researching flight accidents is difficult, painstaking (from determining the composition of the commission and the arrival, as the practitioners of this business say, at the "hole" to the submission of the report for approval) and exceedingly thankless work. The officials of almost every commission, having a limited time interval to perform this work (it is strictly stipulated by the standard documents)—especially the regular staff workers of the flight-safety bodies, often sent to investigate the next flight accident before the ink is dry on the pages of the preceding report—are almost always experiencing the effects of other factors not visible to the uninitiated. They include both an extremely concrete desire by some of the some officers "not to drag things out" and rather to conclude matters with the signing of an order to punish the guilty parties, the energetic efforts of the local authorities not to show their own, first and foremost personal, omissions, and many fatiguing hours of word games by the representatives of various interested organizations and ministries in defense of the honor of their own uniforms, with a doggedness that is really worthy of other application. The representatives of the aviation industry are unfortunately especially zealous in this, as a rule protesting even the most obvious design or production shortcomings. And most of these not very honorable efforts are aimed either openly or covertly at seeing that the complicated picture of the tragedy is smothered or muddied, its sharp edges are smoothed off, without even comparing recent analogous instances or, the more so, without thinking about sound prevention against them in the future.

This is especially noticeable when there is no representative of "independent" offices on the accident or crash investigation commission at all, and it is headed by a local leader. Then there is not even an attempt made to answer even obvious questions. A pilot, for instance, made three steep dives on a training flight in one and the

same zone under the best of weather conditions. Twice he pulled the aircraft out of the dive at the required altitude, but the third time he did not, and moreover did not answer the requests of the flight operations officer and made no attempts whatsoever to bail out. There was one conclusion—pilot error. And no other versions. The document column "Essential Research" had the notation "not required," and the column "Proposals"—"no." Simple and rudimentary—one cause, one guilty party. And did they think some about the next one?

Many years of investigating flight accidents, moreover not only in the Air Forces but in the aviation of other agencies as well, as well as in foreign countries that are more developed in an aviation regard, shows indisputably that a fundamental ascertaining of all causes (or, as they say more often today, factors) manifested in the appearance and subsequent unfavorable development of the emergency situation is essential for effective accident prevention. And that is not just a slogan. Each such factor, after all (from the good working order of a certain unit on board the aircraft to the preparedness of the pilot or crew member—and not in general, either, but in the given area where the hazard arose—piloting technique, operation of the equipment, aerial navigation, weapons delivery, handling of radio communications), is under a completely specific service.

But all of the specialists of these services can work purposefully at ensuring flight safety only when they know the state of affairs with regard to the effect of the specific factor of interest to them on the rate of accidents. And that can be achieved only by summarizing the conclusions from the whole aggregate of the flight accidents being investigated over a certain period of time.

Specialists of the Aviation Flight Safety Service of the Ministry of Defense and scientific-research institutions have recently come to a final conclusion on the necessity of a multifactored approach to understanding the causes of flight accidents. The conceptual foundations of an aggregate of hazardous factors as the real cause of a specific emergency event have been developed in "Concepts for Averting LPs," and when accounting for crashes and accidents two or more causes have begun to appear (shortcomings in the organization of flights, for example, plus a mistake in piloting technique or in the operation of the aviation hardware, design or production flaws in it etc.).

This reality, however, requires the fastest possible transition from the stage of theoretical conclusions to the devising of practical solutions. The multifactor principle, by the way, was proposed as early as the beginning of the 1980s—during the period of the greatest activity of the Central Flight Safety Inspectorate, the predecessors of the USSR Ministry of Defense Aviation SBP. And the main substance of this approach is undoubtedly a detailed investigation of each flight accident, which should uncover and record in the report all factors without exception that facilitated the appearance and, especially, the aggravation of the emergency situation.

The "shopworn" phrases containing one—and not always the true—cause, and moreover frequently presented in a form devoid of concreteness, still figure prominently in the majority of reports. The abbreviation NORP—shortcomings in the organization and supervision of flights—is especially handy. Here is a scenario of an accident that has been repeated more than once. A helicopter deviates from the assigned heading when traversing mountainous terrain, generally running along a depression, and enters clouds concealing the peaks of mountains, colliding with them. The conclusion is unequivocal—NORP. The navigational errors of the crew, their failure to take safety measures when entering cloud cover over rugged terrain and their failure to make use of on-board and ground equipment are once again outside the framework of the investigation. And that means that they do not reach dozens and hundreds of crews, and the next unlucky fellow who will become once again a victim only of poor flight organization will be "singled out" from them.

A typical example of the imparting of significance to the report is the highly detailed consideration in it of those questions that provide absolutely nothing for substantiating the versions and confirming the factors of the appearance and progression of the emergency situation that actually existed. In many reports of crash investigations, absolutely unconnected with the operability of the aviation hardware, the analysis of its preparation and a description of the preserved remnants constitute more than half of the materials—30-40 pages of the reports of the officers of the IAS [aviation engineering service] (from the deputy commander of the unit for mechanics) and a multitude of photographs of units and assemblies. But the carrier of the SOK [objective-monitoring equipment] information—which is mentioned only in passing, the information was not preserved—is not photographed, there is no descriptive data on the pilot and there is no attempt to research the motives of his incorrect actions, the more his making of a decision that proved fatal.

The following phrasing of the cause is encountered most often instead of such concrete specifics—"the permitting of an untrained pilot to fly"—even though it is obvious that any pilot is also allowed to fly in order to raise his training.

They are lately relying more and more on the concepts of the human factor in accidents, as well as the ergonomic imperfections of the aviation hardware, in investigations of flight accidents. Such phrases, unfortunately, are still of an excessively abstract-science or openly distracting nature, where the bringing in of complex terminology pushes aside the obvious essence of the issue. The absence of any requirements at all on either the human factor or on psychological-engineering issues in the standard documentation for the organization and methodology of investigation deprives both of these areas of the right to even occasional testing. Such attempts have been

undertaken only since the middle of 1991. But there is no group of specialists on the human factor on the commissions as before.

The clear-cut delimitation of the components of the human factor into positive (constructive) and negative (destructive), which could be manifested in one and the same pilot in the dynamic of the development of one and the same special situation, would be expedient in the use of the existing theoretical elaborations of it. The positive components are essentially the professionally important qualities of the specific pilot that provide for his avoidance of emergency situations that are his own fault and the localization (offsetting) of those of them that have arisen through external circumstances not dependent on the activity of the pilot. This differentiation makes it possible to focus on the active role of the pilot in preventing LPs and the precursors to them in flight, as well as to analyze the importance of his personal level of ability from both a purely professional and a psychological and intellectual viewpoint.

But no small battle still lies ahead of such content for an investigation report with those representatives of the administrative style of investigating LPs who—without leaving their offices to go to the "hole" from which the smoke is still coming—have already determined those who are to blame and are adopting sanctions according to the first telephone report.

A unification of the efforts of all specialists, science and practice, the widespread utilization of the capabilities of computers, the departmental independence of the investigators, the creation of a system of confidential reports from pilots on dangerous situations in flight and the mandatory participation of specialists on aviation psychology, the psycho-physiology of flight work and ergonomics on the commission will all facilitate the most complete possible analysis of the cause-and-effect links of accidents in the aviation of the armed forces and, that means, a reduction in it.

Letters From Readers

92UM0899D Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 92 (signed to press 23 Dec 91) pp 8-9

[Letters From Readers]

[Text]

You Are That Concerned...

In a forest filled with needles on the shore of Lake Beloye, in Ulyanovsk Oblast, among the graves of the local inhabitants an obelisk crowned with red stars rises up. The inscription on it says, "Lost Fliers Are Buried Here." In the summertime, when fourteen Pioneer camps come to life around the lake, the red-kerchiefed children pass by these fraternal graves in all of their solemn lines. Local conscripts bid farewell here before leaving for the army.

This communal grave—the only sacred place in the whole region—is a marker of the Great Patriotic War. Witnesses relate that then, in '41, an obelisk made of wood was hastily erected over the grave on which the names of the interred were written for those who had perished in an air crash. Years later it was marked by a new one that exists to this day. It was put together of bricks by a local stovemaker. The names of the deceased were unfortunately lost, and a nameless memorial board was attached to the obelisk.

All sorts of rumors and conjectures began to spread concerning the crash. Even such a serious researcher as V. Shavrov, in his book "History of the Designs of Aircraft in the USSR 1938—1950" (Moscow: Mashinostroyeniye Publishing House, 1978, p 53), writes that "Vsevolod Konstantinovich Tairov was an aviation designer who worked at the plant in 1935-41. His activity did not last for a long time—at the end of December 1941 he perished in an air crash (when flying from Moscow to Kuybyshev)."

The crash being discussed here was in reality a tragic episode from the evacuation of State Aviation Plant No. 1 from Moscow to Kuybyshev, and occurred on 29 Oct 41. But very few know of it even today, since the documents on the crash were declassified only in 1986 and have not yet been published anywhere. We offer one of them to the reader:

"Report, 3 Nov 41, town of Baranovka, Penza Oblast.

"A commission composed of GU VVS KA [Red Army Main Directorate of the Air Forces] military engineer 2nd rank A.I. Sokolov, NKAP [People's Commissariat of the Aircraft Industry] flight station department chief V.A. Okorokov and PRIVO [Volga Military District] inspector of fighter aviation Major A.A. Zhemchuzhin conducted an inspection of the crash site of PS-84 aircraft No. 1841608 of the military representation of Plant No. 1 (that occurred on 29 Oct 41 at 16:20 Moscow time two kilometers northeast of Lake Beloye), located on the territory of the town of Beloye Ozero of the Golodnevskiy Rural Soviet of Saratovskiy Rayon in Penza Oblast[1] 25 kilometers east of the city of Kuznetsk."

The commission, as stated later in the report, established the names of the fifteen who were killed, and four some reason named only fourteen of them. In information addressed to the chief of the ZAGS [civil registry office] of Kuybyshev Oblast and declassified simultaneously with the report, Aviation Plant No. 1 Director A. Tretyakov now cites the names of seventeen who perished. They are Lieutenant-General Stepan Dmitriyevich Akimov, commanding general of the 43rd Army; aviation designer Vsevolod Konstantinovich Tairov; Colonel Mikhail Ivanovich Martselyuk, senior test pilot for Plant No. 1; aviation technician 1st rank Georgiy Petrovich

Galitsyn; military engineer 2nd rank Aleksandr Mikhaylovich Zernov; military medical assistant M.P. Metveyev; GU VVS KA representative at Plant No. 1 Timofey Iosifovich Galkin; and, workers N.I. Krivoshapkin, M.N. Simanovich, F.D. Yermolayev, A.P. Komarov, S.D. Petrov, Ye.I. Khodak, G.N. Ilyushin, N.I. Silayev and V.I. Tsvetov from that same plant. The aircraft was being piloted by senior test pilot Nikolay Bertalonovich Fegervari.

The report notes that the names of six passengers of the aircraft consumed by fire were not established, partly for the reason that "the military commissar of the 13th Res. Battalion, Commissar Comrade Reznik, who was present at the initial inspection of the crash site, corpses and personal effects of the crew on 30 Oct 41, completely disoriented the representatives of the local authorities and the NKVD with his instructions to destroy personal effects, some documents and letters of the deceased, as the result of which the work of the commission was made more difficult both in ascertaining the causes of the crash and in the precise composition of the crew[2]."

And last. Attempts undertaken by us to establish the names of all of the deceased in this crash have not yet had positive results. The attempts of the Gremuchin Town Soviet of Ulyanovsk Oblast, on whose territory the grave is located, to replace the obelisk—which has become unsuitable—have also been without result.

Enthusiasts of the former Aviation Plant No. 1 (today the Progress Plant in Samara) have developed sketches of a new obelisk and plans for amenities for the site over the burial. An attempt has been made to include military construction workers in this work, since a unit of them is located nearby. No result. The former command of the Volga-Urals Military District also did not support this initiative. So we are the ones concerned with preserving the memory and monuments, those powerful means of cultivating the patriotism that always was, is and will be the principal measure of the worth of the person.

M. Lapik (Samara)

SOS in the Air

I have been attentively following the debate that has taken shape surrounding military reform in the Air Forces. As a specialist, I am troubled—as are others—by the situation that has taken shape in the communications and RTO [technical support company] units, without which the flights of modern aviation systems are simply inconceivable. And as soon as the discussion concerns not only the management, but also the safety of flight work and the effectiveness of weapons delivery, the necessity of a comprehensive solution to the problems on the agenda is obvious. In order to conduct a topical discussion, I will consider issues that have come up before my colleagues in our—Siberian—military district.

I will begin with figures that, at first glance, will arouse envy among the commanders of other military agencies—the staffing levels of our aviation communications subunits is currently at more than a hundred percent. Slack has unfortunately been created in the interests of combat readiness in the event of... discharges of officers into the reserves ahead of the stipulated terms, tempted by material or moral considerations into civilian life. The causes for this are common to the whole army, and I will not comment on them. But it is worth talking about the omissions that are committed by us and that have aggravated the consequences of objective factors.

Here is one of them. It is clear even to the uninitiated how much the specific nature of military work differs for, say, a radar operator and a communications worker. But the graduates of military schools are distributed among us year after year without regard for the real requirements for officers in specific military fields. It is not enough that the retraining of the novices in the course of performing functional duties is both at our cost and devoid of common sense; such "lateral movements" of personnel are fraught with errors in support for flights and their safety. If one takes into account that we did not get the satisfaction of a single one of our requisitions for radar operators last year, one can imagine what a difficult position individual subunits are in when performing their combat-training missions with essentially reduced personnel.

Taking advantage of the situation, I will not fail to address the junior aviation specialists as well. Here there is a different slant. One of the training subunits is training so many ASU operators that their graduation rate is six times the requirements of the air district. There is nothing to add to this, since making changes in this system is the prerogative of the higher command.

There is another, no less acute question. We ourselves are feeling the slowness of the military-industrial complex in the realization of observations and requests to improve individual assemblies and units of communications and RTO systems. It is understandable that it is not easy to make design changes in series production, the measured rhythm of the conveyor. But when the discussion concerns the purpose, the ultimate aim of our common cause—ensuring the high effectiveness and reliability of items—I think that the lesser of two evils must be chosen here. And I am not talking about an evil here either, but the natural development of hardware and armaments, about the link between science and production that has justified itself in life.

And one last thing. Whether it is the disruption of the mechanism of economic operation or conversion that is to blame for it, today we are encountering more and more unforeseen difficulties in repairs, routine servicing and maintenance of communications hardware. Restoration operations are restrained by a shortage of spare parts and test equipment. In order not to be unsubstantiated, I will cite an anecdotal example right off. In 1991 we received a detail through the supply bodies for... one bulb for an equipment lighting system, while the requirement as reflected in the requisition numbered some four figures.

Thus it obtains that the aviation communications soldiers are performing their missions under far from easy conditions. But believe me, valor of this sort far from brings satisfaction. I would like to find out how my colleagues in other regions get out of this situation, where, we hear, the problems are no fewer.

Colonel V. Zayets (Siberian Military District)

From the Barracks... Into the Barracks

Your journal, touching on sore spots in military reform in aviation, often addresses problems of flight training. The aviation engineering service [IAS], however, is experiencing no fewer problems today. I do not intend to enumerate them, but I think that it is possible to get rid of all sorts of hassles by optimizing the system of cadre training.

The transition to a new standard organizational structure has shown with all clarity that the level of instruction of the special disciplines at the aviation higher educational institutions is lagging behind the urgent requirements of the day. The adoption of a comprehensive method of training aviation technicians for flights, after all, poses a particular accounting for both the competence and the overall world view of future professionals in military affairs. And officers with a "narrow" specialization are coming from the schools as before.

I would add here this absurd fact—the cadets have been studying one type of aviation system for years, and once in the ranks, having become officers, they are retrained on another one from the first day of service. Is it really not possible to count up in good time the requirements of the units for specific specialties with a regard for the aircraft inventory on hand and the prospects for its renewal? Experience in this matter, by the way, has already long been accumulated at the Ministry of Civil Aviation, where the teaching establishments train engineers and technicians on direct order from the aviation enterprises.

I would also say a few words on social protections for young IAS specialists as well. They are significantly lower—again I cannot keep from making the parallel—than for their flying colleagues. Lieutenants came to our garrison for the positions of technician six months ago. These officers with higher education were accommodated... in barracks with bunk beds. It is not surprising that the housing problem, multiplied by the obvious muddle in the organization of their professional activity, has impelled some of the newcomers to doubt the correctness of their choice of life's path. Just try and convince the youth of the prestige of the profession of the person in shoulder boards after this.

Major G. Popryga (Moscow Military District)

Into the Service—By Vocation

Many opinions have been expressed recently on the soldier's work. I have decided to share my own ideas as well, having been discharged into the reserves from the position of aviation mechanic. Perhaps a view from the "soldier's viewpoint" will suggest something useful to those who are at the wheel of military reform.

I do not know how it is in other branches of the armed forces, but I have become convinced over two years that the system of training junior aviation specialists and the procedure for the completion of active military service that are operative in the Air Forces do not correspond entirely to the level of development of modern combat hardware. I can judge by myself. Neither I nor my comrades became the professionals that our army is in such need of. Perhaps we felt ourselves to be more confident in the last six months. It was offensive, honestly speaking, for a technician to be an apprentice. But there is no particular desire to change the situation. Neither among us nor among our mentors.

That is why I am deeply impressed by the idea of a gradual transition to manpower acquisition of specialists for the troops on a socially assured contract basis. The discussion in signing the contract will be on the choice of profession and life's path. And insofar as a person, after two years of conscript service, will in that case be administratively, legally and materially responsible for the section of the work entrusted to him, he will naturally have a vested interest in being trained in the best possible manner for independent labor. You will agree that consciously oriented people will be much more reliable than those who are called into service by obligation, even be it an honorable one.

Sergeant (Reserves) R. Bekmukhametov (Petropavlovsk)

...And By Bread Alone

By virtue of my official duties I often have occasion to visit remote aviation garrisons. Military people, accustomed to making trips, will agree that questions of food cannot always be solved everywhere without excessive nervous strain in all cases. Yes, the food problem has affected each of us. But here is what is extremely surprising—the flight cafeterias and cafeterias for the IAS specialists contain, as before, "Grecian halls" for the commanders of the unit and the inspecting officers.

Their work is crucial, of course, but it must be taken into account that this responsibility is paid for with the corresponding official salary, so the discussion must then concern privileges.

We love to nod to "over there" at every convenient moment. But after all, the presidents of even the most prestigious firms with billions of income in the West feel it their duty to eat in the same dining hall with the workers and office staff. It suits the higher ranks of the national armies fine as well. If we had a little less conceit, I think, we would not have to be discussing the preparation of food in army mess halls. The idea of the priority of the food of ideas over the spiritual would not have to be affirmed in a sated country—man does not live by bread alone, they say. It was Suvorov, however, who said

that it is bad to fight on an empty stomach. And he ate out of a common pot with his soldiers.

I recently dropped in at lunch time to the commissary cafeteria at the Air Forces Main Staff. Expensive and not very tasty. The command personnel, as in the sticks, eats separately. Or, in the sticks as in the capital?

Lieutenant Colonel V. Donskoy (Odessa Military District)

Footnotes

1. Today the town of Beloye Ozero belongs to the Gremuchin Town Soviet of Nikolayevskiy Rayon of Ulyanovsk Oblast.

2. Passengers, it must be assumed.

Health Risk Factors in Pilot Career Longevity Analyzed

92UM0899E Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 92 (signed to press 23 Dec 91) p 10

[Article by Colonel of the Medical Service A. Ivanchikov and Candidate of Medical Sciences Colonel of the Medical Service V. Chuntul under the rubric "To Aviators on Health": "Risk Factors in Flight Longevity"]

[Text] An analysis of the nature of illness of the cardiovascular system among flight personnel has made it possible to ascertain various **risk factors** (RF) that facilitate the development of arteriosclerosis and its outcome—ischemic heart disease. There are about 230 risk factors, but the following have been deemed the most significant ones in their effects on the person: limited physical activity (hypodynamia), smoking, excess weight, psycho-emotional burden and a rise in the level of cholesterol in the blood and blood pressure, as well as age.

Limited physical activity—the most widespread RF among flight personnel. Some 80-90 percent of pilots are susceptible to it. The occupation of fliers with "sitting" forms of class sessions and the desire to make the maximum use of official and private motor transport have made this contingent the least mobile one in the Air Forces, which is especially ruinous for a person's cardiovascular system.

The second most hazardous risk factor is **smoking.** More than half of the flight personnel smoke. This harmful habit is in most cases "assimilated" even before the obtaining of the flight profession—in school or at flight school.

Excess weight—the third exceedingly substantial risk factor—is characteristic of roughly 45 percent of the flight personnel, including even the young pilots of maneuverable aviation. It is principally a consequence of excessive eating and hypodynamia, as well as the effects of heredity (one out of ten cases).

Table 1 presents the normal weight for fliers 30 years of age (an increase of up to 6 kg versus those indicated in the table is permitted for those older than 30).

Table 1

	Optimal weight (kg) with build:		
Height, cm	narrow	medium	wide
160	53.5	60.0	66.0
165	57.1	63.5	69.5
170	60.5	67.8	73.8
175	65.3	71.7	77.8
180	68.9	75.2	81.2
185	72.3	79.2	85.2
190	76.2	83.1	89.0

Psycho-emotional burdens are an exceedingly widespread, albeit difficult to take into account, risk factor. The increased complexity of aviation hardware, enhanced requirements toward the quality of fulfillment of flight assignments and family problems—these and other problems put all categories of flight personnel into a situation requiring great psycho-emotional stress, and cause a stressed state both in the course of flights and on the ground.

Such RFs as a **rise in the level of cholesterol in the blood and blood pressure** are connected with complex biochemical and physiological processes transpiring in the organism, and are the most reliable predictors of arteriosclerosis.

Mathematical processing of the data has made it possible to extract average coefficients of the significance of the most hazardous RFs (Table 2).

Table 2

Risk factor		Points
Age	N complete years	0.04N
Branch of aviation	transport	1.0
	long-range	1.5
	army and ground-attack	2.0
	fighter	2.5
Body weight	normal	0.0
	more than 10 percent above norm	1.0
	from 10 to 20 percent above norm	2.0
	more than 20 percent above norm	3.0
Smoking	does not smoke (stopped smoking more than a year ago)	0.0
	stopped smoking less than a year ago	1.0
	smokes up to 10 cigarettes a day	2.0
	smokes 10-20 cigarettes a day	3.0
	smokes more than 20 cigarettes a day	4.0
Physical activity	daily calisthenics, running up to 5 km, sports and exercises in the BP system	0.0
	daily calisthenics, exercises in the BP system	1.0
	exercises in the BP system	2.0
	not engaged in at all	3.0
Blood pressure	110—130/70—80	0.0
	130—140/90	1.0
	150—160/80—90	2.0
	150—160/100—110	3.0
Blood cholesterol, µmole/liter	up to 5	0.0
	5—5.5	1.0
	5.5—6.0	2.0
	more than 6	3.0

So then, the likelihood of getting arteriosclerosis is, depending on the total quantity of points, very low for under 5.5, low at 6.0—7.0, likely at 7.5—8.0 and high at more than 8.0.

Cardiovascular disease is conditioned for a specific pilot by an aggregate of subjective and objective factors. The elimination or, at least, lessening of their negative effects should thus also be implemented comprehensively through a combination of various measures undertaken by the pilot, aviation physician and commander.

The pilot is the most highly motivated and capable individual in this triad. His personal inclinations and conscious activity in countering most of the RFs cannot be replaced by any other conditions. Essential on the part of the pilot are rejection of harmful habits (smoking, alcohol), physical activity (morning exercises and sporting functions during the day) and the self-organization of labor and rest, as well as self-regulation of the personal behavior in service and in everyday life.

The task of the aviation physician consists of correlating the essential measures for the prevention of illness with the stressful rhythm of the life of the units and its optimization. Businesslike contacts with the commanders and superior officers are especially important herein. Such methods as explanation of the necessity of avoiding the appearance of RFs to the pilots and members of their families are also of no small significance.

The commander of the aviation unit (or subunit), organizing the whole process of flight and everyday work of the subordinates, has an immediate effect on the appearance of most of the RFs, both for all flight personnel and for himself. It is no secret that some commanders themselves frequently foster stressful situations even under ordinary conditions.

It would not be superfluous, by the way, for the Air Forces Combat Training Directorate and the medical service to conduct a comparative analysis of flight longevity, including the premature disqualification of pilots for health reasons, among units that are under similar

conditions. This would allow a more objective evaluation of the state of affairs in aviation collectives in maintaining the health of the fliers.

Development of Soviet Fighter-Bomber Tactics Surveyed

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[Article by Candidate of Military Sciences Colonel (Retired) Ye. Lavrentyev under the rubric "Air Forces Tactics: History of Development": "Fighter-Bombers"]

[Text] *In May of 1957, a year after the abolition of ground-attack aviation (ShA) in the Soviet Air Forces, fighter-bomber aviation (IBA)[1] was created in its stead. The topic of today's discussion is how the tactics of the IBA developed, and what its prospects are, with the resurrection of ground-attack aviation in the 1980s.*

The principal mission of the newly created branch of aviation was to support troops or naval forces via the destruction of important targets, chiefly small and mobile ground or naval ones, at tactical and close operational depth. IBA [fighter-bomber aviation] could be included in aerial battle with manned and unmanned enemy aircraft, as well as to perform aerial reconnaissance.

The aircraft inventory of the IBA units initially consisted of subsonic MiG-15bis fighters that had earlier been part of the ShA and were performing the role of bombers after its disbanding, for which they were not suited at all due to their small bomb loads, lack of the necessary bombsight and navigational equipment and poor survivability.

The fighter-bombers began to employ a broader arsenal of tactical devices for making a strike in operations against ground targets compared to ground-attack aircraft: they carried out bombing from horizontal flight (H = 300—500 m [meters]) and from a dive (θ_{dive} = 10—40 or 50—60°), the firing of non-guided aviation rockets (NAR) and cannons (from θ_{dive} of 5—15 or 20—30°) at initial attack speeds of from 400 km/hr to the maximum allowable, with bombings from θ_{dive} = 30° and firing of cannons and NARs from θ_{dive} = 15—30° at night and in twilight against targets illuminated on the ground.

Fundamentally new and more complex methods of attack were successfully developed as well—toss bombing ($\theta_{pull-up}$ = 45 and 110°, Fig. 1), bombing and strafing after the performance of a chandelle or immelman from θ_{dive} = 30—40 or 50—60°, and firing from cannons, NARs and bombing in one attack from θ_{dive} = 10—40°.

The parameters of attacks in all their diversity were put in order somewhat for the purpose of creating more favorable conditions for the assimilation by the flight personnel of the tactical devices for making strikes against ground targets. Attacks after the performance of a chandelle, immelman or loop thus came to be implemented only from a dive angle of 30° (Figs. 2-4).

It must be noted that the immelman and the loop are strictly designed maneuvers providing for the sufficiently precise arrival of the aircraft at the point to initiate the dive on the target when piloting an aircraft by instruments alone, without the constant visual contact of the pilot with the target. The pilot has the opportunity of observing the target for the greater portion of the process of performing the chandelle. Toss-bombing against ground targets is practiced by the IBA pilots with a regard for the prospects for the aircraft being equipped with nuclear weapons.

The attacks of ground targets are accomplished from simple types of maneuvers by single crews, in pairs and by flights; after the performance of a chandelle, immelman or loop by single crews and pairs; and, in toss-bombing by single crews only. The bombing is performed both by command of the lead and with individual sighting, while the firing is performed only with individual aiming of each pilot against his own target.

Attacks from complex types of maneuvers made it possible to carry out a strike against an enemy in the shortest possible time from the moment of his detection by the pilot at an inconsiderable distance, provided the approach to the target is at very low altitude and top speed. Energetic changes in the altitude, speed and direction of the flight in the process of executing an attack lowered the effectiveness of the opposition of all types of enemy air-defense weapons in the target area to a considerable extent. Reductions in the time the fighter-bombers are in the lethal zone of the target air defenses were also achieved through the use of all of the weaponry on board the aircraft in one pass. Additional maneuvers were employed for repeated passes (if the attack could not be made on the go) at the target—two chandelles at 180°, a standard chandelle and a chandelle at 270°.

During the process of combat training the flight personnel of the IBA mastered actions against previously assigned targets and by call from alert stations on the ground or in the air, as well as practicing the independent search and destruction of targets (targets of opportunity). The combat procedures of the fighter-bombers therein consisted, as a rule, of strike groups and support groups: follow-up reconnaissance, target search and detection, air-defense destruction, and cover against attacks by enemy fighters.

The destruction of airborne targets became a fundamentally new task for the IBA. It was assumed that the fighter-bombers would be involved in it to augment the efforts of frontal-aviation fighters in repelling mass raids by enemy aircraft. The IBA pilots practiced standard attacks against bombers, firing from cannons against high-speed aerial targets, waged aerial battles against solitary crews and pairs, performed intercepts of an airborne enemy in pairs and in flights by day under good

weather conditions (PMU) and behind clouds, at low, medium and high altitudes with guidance from command posts in this regard.

The Su-7B supersonic jet fighter-bomber and modifications of it began to come into service with the IBA starting in 1960. A number of units armed with MiG-17 aircraft—which in combat capabilities were little distinguished from the MiG-15bis—were also transferred to it from frontal aviation.

It should be noted that aircraft of the Su-7B type possessed better capabilities than the MiG-17 and MiG-15bis for the destruction of ground (naval) and airborne targets—they could be fitted, aside from the conventional ordnance, with nuclear weapons, and they had bombsight and navigational equipment entirely modern for the times on board.

The Su-7B type aircraft employed in principle the same methods of attack as the MiG-17 and MiG-15bis (differing only in the parameters of their execution). Attacks from simple types of maneuvers were executed by solitary crews and pairs from horizontal flight and from a dive at θ_{dive} = 10—20° at V=800—1,050 km/hr by day and at twilight in PMU, as well as under limited visibility and low cloud cover in the daytime.

Attacks from complex types of maneuvers were also executed under analogous weather conditions. The entry into vertical maneuvers is made at H = 200 m and V = 1,050 m/hr. Attacks after the performance of a chandelle, immelman and loop were accomplished from a dive angle of 45°, and in the first case only without the pass of the aircraft into a cloud, and in the second and third with the pass of the upper part of the maneuver into the clouds (with an altitude of the lower boundary of no less than 2,000 m). Toss-bombing with $\theta_{pull-up}$ = 45 and 110° can be accomplished with the execution of a vertical maneuver and the release of the bombs in the clouds or behind the clouds (at an altitude of their lower boundary of no less than 500 m). Only the speed of entry into the maneuver changed for the MiG-17 as compared to the MiG-25bis—it increased from 800 to 870 km/hr.

One typical feature of the tactics of fighter-bomber aviation at the time was the rejection of the possibility and expediency of making simultaneous strikes with large numbers of aircraft. It was felt, for example, that in connection with the increased firepower of aircraft (especially when they were employing nuclear weapons) it was not necessary to allocate a large detail of forces for most ground targets against which the operations of IBA were directed. The opinion was current at that time that the execution of flights as part of large groups was too complicated—and even unsafe—due to the appreciably increased speeds of aircraft flight and the supposedly appreciable worsening of their maneuvering characteristics.

The formation of these erroneous views occurred for a number of reasons—the combat capabilities of the Su-7B and MiG-17 aircraft to defeat various ground targets were unfoundedly exaggerated, an incorrect orientation toward the nature of the combat operations was taken (the wager was placed chiefly on the use of nuclear weapons against individual, small and mobile targets), it was felt not to be expedient to make simultaneous strikes by large forces against area targets, the actual capabilities of the enemy air defenses and the prospects for improvements in them were underestimated and the maneuvering qualities of these aircraft were unfoundedly understated; the possibility of making simultaneous strikes by squadrons and regiments was thus rejected.

The fighter-bombers ceased practicing attacks against ground targets after the execution of an immelman or loop in 1967, and attacks after the execution of a chandelle in Su-7B aircraft were made principally from θ_{dive} = 30° (only bombing was made from an angle of 45°, and that just as a way of improving the proficiency of the flight personnel), which with the preservation of the speed of entry of the aircraft into the vertical maneuver at 1,050 km/hr led to an increase in the duration of the time the aircraft was in the straight portion of the dive from 4—6 to 11 seconds and increased the likelihood of its being hit by enemy air-defense weapons in the target area. This step was a direct consequence of the willful approach of the Air Forces command to solving the problem of ensuring flight safety without regard for its negative effect on the actual ability of the aviation units to accomplish their combat missions successfully under realistic conditions.

Practice has demonstrated convincingly that attacks on ground targets after the execution of an immelman and from a loop pose no particular difficulty for pilots, and can be performed by them even with the presence of low cloud cover in the target area (with the entry of the aircraft into the vertical part of the maneuver in the clouds), when a strike from θ_{dive} = 30—45° after the performance of a chandelle becomes impossible. It is thus no accident that some of the effective methods of attacking ground targets that were earlier unwarrantedly removed from the arsenal of tactical devices of fighter-bombers are currently being returned to the combat training of IBA units.

As for the practicing of toss-bombing from a pull-up angle of $\theta_{pull-up}$ = 45 and 110° using Su-7B aircraft, the persistent necessity for it receded in the middle of the 1970s, since with the qualitative improvement of nuclear weapons the possibility of practicing dropping such ordnance from both horizontal flight and from a dive appeared.

The fighter-bombers began to carry out night bombings and cannon and NAR firing from a dive against targets illuminated from the air by aerial illumination flares. Due to the occasional outbursts of flight accidents in the practicing of this type of weapons delivery, however, it was banned twice, in the first half of the 1970s and the 1980s. Only bombing from horizontal flight and from a dive against targets illuminated on the ground were practiced during those time periods.

In the second half of the 1960s the fighter-bombers, in operations against ground targets, began to employ not only sequential strikes by pairs and flights, but also simultaneous strikes in common battle formation by squadrons and regiments using various types of weapons. Optimal battle formations varying in their composition of groups were researched and adopted into the practice of combat training for IBA units, and a technique and standards for evaluating the results of group strikes against area and linear targets were developed. The principal criterion became not the total results of the delivery of weapons by individual pilots, but rather the overall number of small targets making up the composition of the strike target that were hit by the group. The IBA adheres to this technique even today.

Further improvements in tactical devices have taken the direction of seeking out new methods of attacking ground targets that would provide for an expansion of the capabilities of fighter-bombers to overcome enemy air defenses and for high effectiveness of their strikes under various weather conditions, including with low cloud cover.

Such new methods as attacking from an Su-7B aircraft by firing NARs (S-5K) with H = 25—100 m when flying on a logarithmic curve (Fig. 5) and attacking from Su-7B and MiG-17 aircraft with θ_{dive} = 10—20° after the performance of a chandelle and steep climb (Fig. 6) were thus developed and adopted into practice in 1968. The optimal time for an aircraft of the Su-7B type to be on the straight portion of the dive was ensured therein through a reduction of the speed of entry into vertical maneuver from 1,050 to 900-950 km/hr.

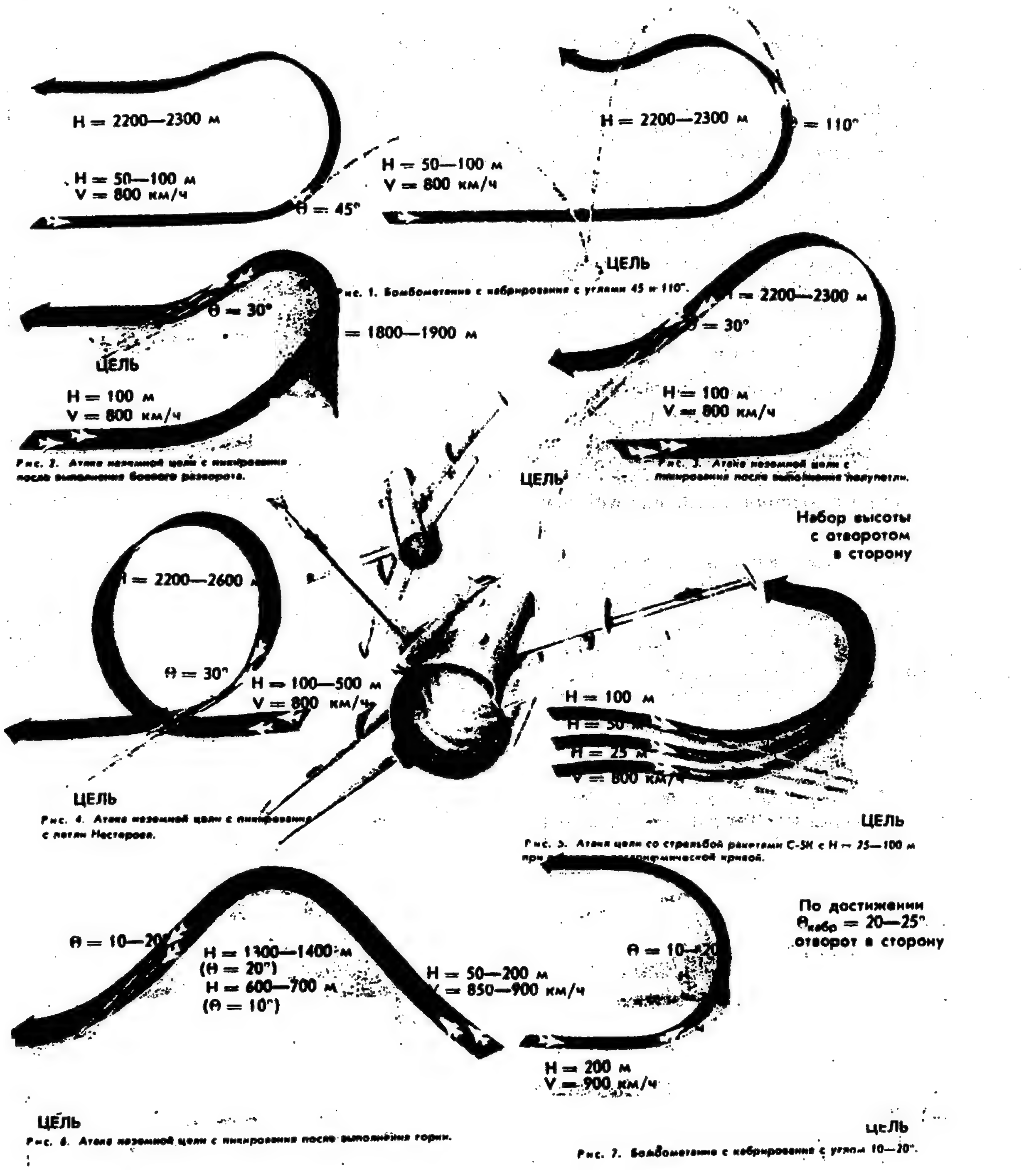
Fighter-bombers began to make use of high-explosive and fragmentation bombs with braking devices, as well as special ground-attack aerial bombs that were adapted for dropping from 50 to 500 m, at the beginning of the 1970s. The pilots of the Su-7B aircraft began to assimilate toss bombing from $\theta_{pull\text{-}up}$ = 10—20° to make strikes against previously assigned group (linear and area) ground targets using expendable bomb cluster dispensers, expendable bomb clusters and special aviation ordnance, as well as conventional large-caliber aerial bombs with the installation of instantaneous-action fuzes on them (Fig. 7).

Attacks of ground targets from θ_{dive} = 10, 20 and 30° after the performance of a so-called optimal chandelle with entry into the vertical maneuver at H = 25—100 m and V = 900—950 km/hr was being practiced along with this at the same time, making it possible for the pilot not to lose visual contact with the target during the process of this maneuver and to put the aircraft into the dive in good time at the assigned angle. This maneuver was considered to be one of the most complex, and was thus employed only by solitary crews.

A technique for the execution of solitary bombing apropos of the dropping of nuclear bombs from θ_{dive} = 45° after the execution of a chandelle using engine afterburner mode was also developed and adopted into practice.

Many of the methods of attacking ground targets employed by the fighter-bombers were connected with the execution of maneuvering at low and very low altitudes. The flight personnel of the IBA have thus persistently mastered advanced aerobatic maneuvers at those altitudes from the moment of its creation, and before 1972 had even outstripped the fighter pilots somewhat for this indicator.

(Conclusion to follow)



Key to figures:
1. Toss-bombing with angles of 45 and 110°
2. Attack of ground target from dive after execution of chandelle
3. Attack of ground target from dive after execution of immelman
4. Attack of ground target from dive from loop
5. Attack of target firing S-5K rockets from H = 25—100 meters when flying along logarithmic curve; gain of altitude with turn to the side
6. Attack of ground target from dive after execution of sharp climb
7. Toss-bombing from pull-up with angle of 10—20°

Development, Service of Tu-128 Heavy Interceptor Recounted

92UM0899G Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 92 (signed to press 23 Dec 91) pp 18-21

[Article by N. Yakubovich and N. Soyko under the rubric "Domestic Aviation Hardware": "Fame After... Salvaging—*On the Tu-128 Long-Range Interceptor*"]

[Text] The skies over Moscow shook with the thunder of aircraft flying by on a cool July day in 1961—aircraft of virtually all types created in the Soviet Union were being displayed in an aerial parade. Now we know that this was a sort of "farewell" to aviation for many long years, since cutbacks in the Air Forces were underway and many design bureaus were being closed or converting to the design engineering of missile technology. Only two of the aircraft being demonstrated in the parade had been given leave to live. They included the prototype of the Tu-128, which had become the principal part of a system of long-range intercept for aerial targets.

The first aircraft with that designation (the La-250-K-15) was created at the OKB [Experimental Design Bureau] of S. Lavochkin in 1956, but the difficulties that were encountered by the aircraft's builders proved to be too great and did not make it possible to bring the aircraft along to being accepted for service. The refusal to pass along the La-250 in no way signified that the country did not need such aircraft. The danger of the penetration of B-52 strategic bombers and Snark cruise missiles from the direction of the Arctic onto our territory had increased sharply by the end of the 1950s. The tactical performance requirements for a system for this purpose were specified once again, and the assignment issued to the OKB of A. Tupolev. This was not comprehensible to many specialists, including foreign ones—the firm on Radio Street, after all, specialized in heavy bombers and passenger aircraft. That is why the foreigners, seeing the prototype of the Tu-128 in the Moscow skies, ascribed it to a different design bureau for a long time.

The new aircraft was to replace the Yak-25 and provide for the intercept of targets flying at altitudes of up to 21 km [kilometers] at speeds of 2,000 km/hr, as well as their prolonged (more than two hours) escort.

Work on the creation of the Tu-128 did not begin from zero. The Tu-98 supersonic medium-range bomber—the first flight of which was made by test pilot V. Kovalev—had been created at the OKB as early as 1956. It had also undergone plant testing. A. Tupolev organized and headed the work aimed at developing the aerodynamics for a wing with large sweep, the speed profiles of the wing, the theory of booster control systems and the application of afterburner TRDs [turbojet engines] at the end of the 1950s in order to realize the plans for the supersonic aviation systems.

The look of the future Tu-128 was formulated in a team of general forms under the direct supervision of S. Yeger. I. Nezval became the chief designer of the aircraft. The mock-up was approved in 1960, and OKB test pilot M. Kozlov and test navigator K. Malkhasyan set about the flight testing of the Tu-28-80, the prototype of the future Tu-128, on 18 Mar 61.

The aircraft was initially designed for VD-19 engines of the design bureau of V. Dobrynin. They constantly overstepped the deadlines stipulated by the government, which put the aircraft builders into a difficult position. That was the reason for the installation of engines from the OKB of A. Lyulka on the experimental Tu-28-80, and later on the series-produced Tu-128.

The first experimental aircraft differed insignificantly from the series-produced one, chiefly by the geometry of the wing and the number of missile racks, brought from two to four in series. Two ventral fences were located under the tail section, intended to reduce the frontal resistance from the ventral fairing.

V. Ivanov and G. Beregovoy (a future cosmonaut of the USSR) were designated the test pilots from the Air Forces NII [Scientific-Research Institute]. A considerable deviation of the tactical performance characteristics from the assigned values was detected in the course of the state testing of the aircraft that began on 20 Mar 62. This required the performance of prolonged refinement work on the intercept system, which somewhat pushed back the time periods for its acceptance into service.

It was also detected in the course of testing that the aircraft, in flight at subsonic speeds, had little longitudinal stability, and the hanging of missiles led to an even greater reduction in reserves of it. And at supersonic speeds exceeding Mach 1.45, there was a reverse roll reaction to the pedal settings. Such effects required additional attention from the pilot. This evoked the necessity of creating a training version of the aircraft. A third cockpit—for an instructor—was accommodated in the nose portion of the fuselage.

The aircraft is a two-engined monoplane executed according to the classic configuration with side air intakes. The centrally positioned wing of monocoque design with two spars consists of a center plane built into the structure of the fuselage and cantilevers with a sweep angle of 56°22'24". Gondolas are located in the middle portions of the cantilevers for retracting the landing gear. The leading edge of the wing is fitted with a thermal anti-icing device.

The fuselage is semimonocoque, and is executed according to the rule of areas for the purpose of reducing the frontal resistance at supersonic speeds. Eight fuel tanks are located in the central portion of the fuselage. The target-detection and missile-guidance gear, created under the leadership of Chief Designer V. Volkov, is located in the forward portion of the fuselage along with a two-seat pressurized cockpit for the pilot and navigator/weapons officer with KT-1 ejection seats. Red and white lighting were envisaged in the crew cockpit.

The aircraft empennage consists of a controllable stabilizer with elevators and a directional rudder. The end of the tail fin is cut at an angle to the design horizontal of the fuselage in the form of a plane in order to increase the critical speed of flutter. The leading edge of the tail, like the wings, is heated with hot air drawn from the fifth stage of the engine compressor in order to fight icing.

The power plant consists of two AL-7F-2 engines, modifications of the AL-7F-1 with increased thrust. They made it possible to bring the maximum speed of flight with four missiles to 1,665 km/hr (Mach 1.57) at an altitude of 11,000 meters, and to 1,910 km/hr (Mach 1.8) without missiles. AL-7F-4 engines were installed on later modifications, which made it possible to bring the Mach to 1.96, as were VD-19 engines.

The control of the aircraft is single and rigid. Its principal organs were the stabilizer, rudder and ailerons. The elevator was kept by and large as an emergency control organ. The rudder and ailerons were equipped with trimmers. The aircraft was provided with transition from hydraulic control to conventional manual (pedal) for all three channels. The reverse conversion was possible only for the rudder and ailerons. Spoilers were intended to avert the aircraft's reaching of critical angles of attack and for braking when landing.

The armaments consist of four R-4 air-to-air missiles created at the OKB of M. Bisnovat. Two of them had heat-seeking heads, and two had radar heads.

A special pod in the tail section accommodated a braking chute 50 m^2 in area. The pod was insulated with a heat-insulating housing to protect against burning from the engines.

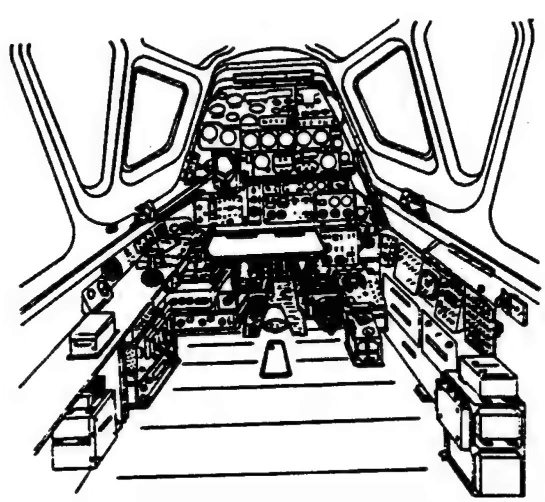
There were distinctions in the design of the airframe, including in the cockpit glass, depending on the aircraft series.

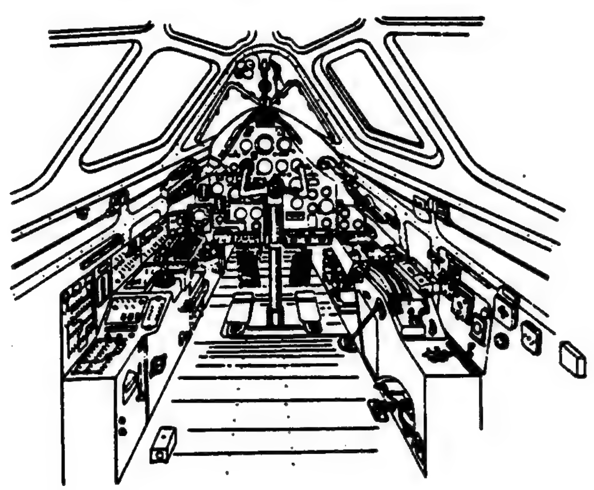
An autopilot (AP-7P), navigational system (NBU-B1) and piloting and navigational gear ("Put-4P") were installed on an interceptor for the first time in domestic practice, and provided for semi-automatic control in horizontal flight and on an assigned heading, approach to the airfield, landing approach and return to an assigned point, as well as aiming when launching a missile.

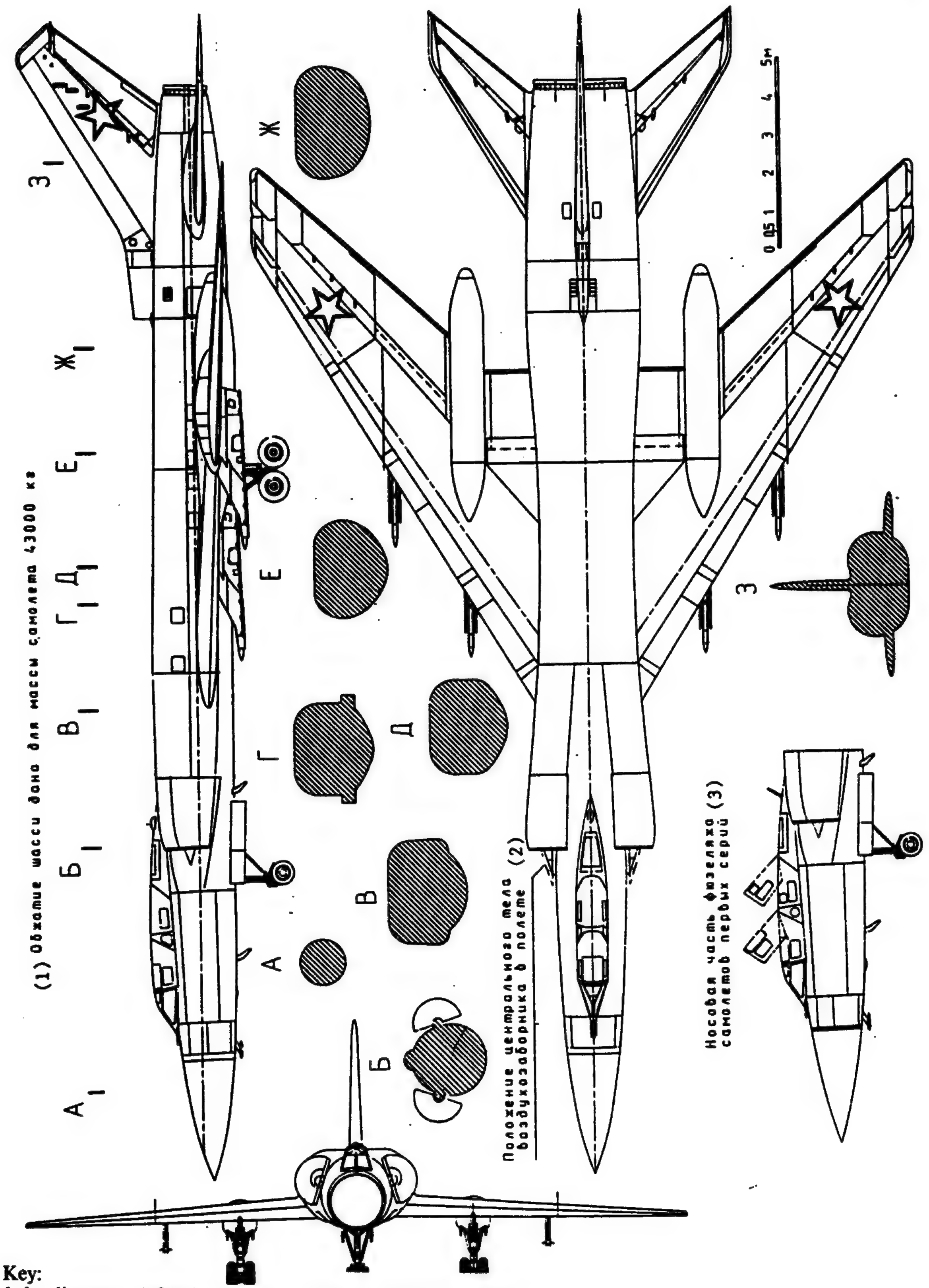
The Tu-128 was in service with the air defenses for almost 20 years, and provided reliable protection for the country's airspace against uninvited guests.

Principal Characteristics of the Tu-128 Aircraft

Maximum takeoff mass, kg	43,000
Fuel mass, kg	14,850
Maximum combat load, kg	1,900
Maximum engine thrust, kgf:	
—without afterburner	2 x 6,900
—with afterburner	2 x 10,100
Practical flight range, km	2,565
Practical flight duration	3 hr 4 min
Practical ceiling, meters	15,600
Maximum Mach	1.8
Cruising Mach in loiter mode	0.85
Takeoff run, meters	1,350
Landing runout, meters	1,050
Armaments:	
—4 air-to-air guided missiles with semi-active radar and infrared homing systems	
Maximum launch range, Km	40
Equipment:	
—radar with long-range detection, providing the opportunity to intercept targets in the forward and rear hemispheres	







Key:
1. landing-gear deflection given for aircraft mass of 43,000 kg
2. position of central body of air intake in flight
3. nose portion of fuselage of aircraft in the first series

Military Space Plans for 1992 Outlined

92UM0899H Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 92 (signed to press 23 Dec 91) p 41

[Article by Space Units Chief Colonel-General V. Ivanov under the rubric "Space Sciences: Prospects for Development": "What is the Coming Year Preparing for Us?"]

[Text] The past year was one of the most difficult for domestic space science. The fulfillment of projected plans and programs was made more difficult to a considerable extent by cutbacks in appropriations, disruptions of contract ties among republics and worsening political and socio-economic problems in the country. An outflow of highly qualified specialists from the space sector began.

The principal tasks facing the Space Units of the USSR Ministry of Defense and the space sector in general, however, were fulfilled even in the face of these difficult and unusual conditions.

This became possible, in my opinion, only thanks to the significant reserve of strength that had been created over the 30 years of development of our space science in the realm of the creation of material-and-technical and production bases, the organization of work, the set-up of cooperation and the training of cadres.

But any reserve of strength is not limitless. After the disbanding of the USSR Minobshchemash [Ministry of General Machine Building], the lead ministry on space topics, the principal weight of responsibility for the state and development of space science landed on our units. And we feel that the chief task of 1992 is the preservation of the accumulated space potential of the country.

Space science is one of the few realms in which we have a rough parity with the United States and are substantially ahead of all other countries, including the developed countries of Western Europe. This is our national property. We are thus planning to take an active part in the formulation of space policy and the managing bodies of space activity, both on the scale of the country and in the republics. We understand the strivings of the republics to expand their independence in this realm. This especially pertains to the RSFSR, on whose territory about 70 percent of our space potential is located, and to Kazakhstan, where the Baykonur cosmodrome is located. We are ready for a constructive dialogue for the purpose of devising a unified and coordinated stance. There should be one criterion of truth—not to lose leadership and to ensure the efficient application of space hardware in the interests of the country's security, the national economy, science and international collaboration.

The Space Units have prepared a series of proposals to improve the management of space activity in the country and the republics, which—in our opinion—take into account the interests of all the parties.

In 1992 we will have to adopt a long-term program for the creation and development of space hardware for military purposes. All scientific-research and design operations, procurements and expenditures for capital construction and the building of the space infrastructure, including facilities for social and everyday purposes, will be tied together in that program within the limits of the appropriations allocated to us.

The development of a long-term program for the creation of space hardware for civilian purposes in order to resolve national-economic tasks (communications, navigation, meteorology, research of the natural resources of the Earth, cartographic and topogeodesic support, researching the planets of the solar system and many others), as well as in the interests of expanding international collaboration, is also being planned at the same time and with our active participation.

Taking into account that military and civilian space hardware utilizes a unified infrastructure (cosmodromes and the command and measurement complex) and is created at the same enterprises, as well as the specific feature that virtually all military space hardware can be used in the interests of the national economy to this or that extent, we feel it essential to unite these expensive programs into a unified State Program for the Assimilation and Utilization of Outer Space.

Our units face a great deal of work in the realm of military space to maintain the orbital groups for early warning of missile attacks and observation in a combat-ready state, including in the interests of monitoring and observing international treaties and agreements, navigation, communications and command and control.

The year 1992 is a special one for space science. It has been declared the International Space Year. Our country will be taking an active part in conducting it. The program of manned space flights will continue. Cosmonauts will conduct dozens of experiments in the Mir space station for the purpose of obtaining materials and medicines with unique properties, running through promising space technologies and researching the effects of space on the human body. A commercial launch of the Soyuz craft with a German cosmonaut is planned in March, with a French one in July. The next large-scale module for the Kvant class orbital station, equipped with apparatus to research the natural resources of the Earth and study the upper layers of the atmosphere and outer space, is also being launched.

A continuation of flight testing of the Energiya—Buran space transport system is planned at the end of the year. The launch of an unmanned Buran craft and its docking with the Mir station is envisaged therein. The station crew will conduct a series of experiments, carry out the verification of the on-board systems of the orbital craft and transfer various cargo to it (research materials and apparatus) for delivery to Earth during the period of joint flight. The landing of the Buran will take place in

automatic mode at the Baykonur cosmodrome, as was performed in the first flight of 15 Nov 88.

Flight testing of a new hydrometeorological space system will begin in 1992. Global observation of the weather situation will be ensured with its start-up, while the timeliness of the information will be more than quadrupled.

Our launch vehicles will put spacecraft into orbit for communications and television. They include a satellite of the Ekran type, which is the sole means of bringing televised and radio programs to areas of West Siberia and the north of Russia, along with the next Gorizont satellite for Russia.

It will become possible to encompass the entire territory of Kazakhstan in 1992 with the start of flight testing of the prospective Gals satellite for direct television broadcasting.

The placement into orbit of a whole series of satellites for cartography and researching natural resources of the Resurs and Okean types has also been planned.

The year 1992 will be a saturated and complex one overall. The cosmodromes at Baykonur and Plesetsk will be operating at full capacity as always. The command and measurement complex will provide for around-the-clock duty for the purposes of the timely and stable control of the orbital systems.

It is obvious, however, that the fulfillment of our space program will depend on the successful performance of the all-round transformations projected in the CIS.

Development History of Soviet Predecessors to Buran Spacecraft

92UM0899I Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 1, Jan 92 (signed to press 23 Dec 91) pp 42-43

[Article by V. Ageyev under the rubric "Unknown Pages of Space Science": "In Flight—The 'Bor'"]

[Text] Work was underway at the Flight Research Institute [LII] imeni M.M. Gromov during the period from 1966 through 1976 on the creation of an orbital craft (OK) for the Spiral aviation-space system. Just what was that system?

The two-stage air and space system, developed at the OKB [Experimental Design Bureau] imeni A. Mikoyan under the leadership of Chief Designer G. Lozino-Lozinskiy, consisted of a 52-tonne aerial craft/accelerator and a 10-tonne experimental manned orbital aircraft (EPOS) 8 meters in length with a wingspan of 7.4 meters that was launched from its "back" (at an altitude on the order of 30 km).

A subsonic analogue of the EPOS, created in the middle of the 1970s (article 105.11), was reminiscent of today's Buran, but in miniature. It, as any aircraft, had wings, a tail assembly and control surfaces—ailerons, rudder and trim flap. Only the landing gear looked unconventional. It had four struts, on which there were metallic skids rather than wheels, with the aid of which the analogue could land on virtually any type of ground. Approaches were made with it by test pilots I. Volk and V. Menitskiy, as well as Heroes of the Soviet Union A. Fedotov and A. Fastovets. Flights of the analogue with its decoupling from the Tu-95K carrier aircraft were later performed.

Every generation of airframes, as is well known, contains a number of fundamentally new solutions. But as opposed to many years of experience in aviation, where various regimes could be tested gradually in the process of refinement, confidence was essential in the fulfillment of reliability requirements on the very first flight for a space plane. Such an airframe, after all, would pass through all realms of gas dynamics—from the regime of free molecular flow to the regime of the classic boundary layer—when entering the atmosphere with subsequent descent. Flying models (on the scales of 1:3 and 1:2) that received the overall name of Bor were thus created for the solution of those problems and questions of controlling the EPOS at supersonic and subsonic speeds in the upper layers of the atmosphere, as well as evaluating the temperature conditions on its surface. These tests were conducted in 1969-73.

The history of the creation of the model itself is an interesting one. As early as 1967, in accordance with the research plan, it was necessary to manufacture a flying model of the Bor with a weight of up to 800 kg and a length of 3 meters that was to be separated from a launch vehicle (at an altitude of 100 km at a speed of 3.7 km/sec) and complete a gliding flight in the atmosphere. But how could they protect the structure of the model against the heat, where the nose portion was to reach 1,500—1,600°C? Major specialists on aerodynamics expressed doubts on the possibility of balancing an airframe of such unconventional configuration—a "lifting body"—at angles of attack reaching 45°. The answer had to be provided as quickly as possible, however, since the fate of the whole Spiral project depended on it. The collective of the LII was able not only to design, manufacture and conduct ground trials over two years, but also to make a launch of a Bor in July of 1969 in conjunction with the rocket personnel. The results of the testing showed that the "lifting body" was excellently balanced even at angles of attack exceeding 60°. And even though the first model was a scale-weight mock-up made of wood and equipped with apparatus, scientific results were obtained using namely that before its burn-up at altitudes of 60-70 km.

The balance and the characteristics of longitudinal stability were clarified (compared to the data from wind tunnels) after the research that was conducted under physical flight conditions of models of the Bor-2 and

Bor-3. Experimental data were obtained on the conversion of the laminar boundary layer into a turbulent layer, data on the effects of altitude and flight speed on the distribution of pressure across the surface of an airframe apparatus of complex geometric shape were obtained and algorithms of the control of its movement were tested, while extensive research was conducted on aerodynamic heating, heat exchange and thermal protection of various elements of the surface.

A profound study of the data obtained showed that the resolution of these issues under the physical conditions of flight was technically impossible to accomplish using traditional methods of modeling an OK of one type. The LII thus proposed that they be conducted using two flying models in this regard.

One of them—Bor-4—was a version of an aerodynamic apparatus with a "lifting body," on which the reproduction (in dimensions, shape and construction) of actual fragments of the nose blunting of the lower and upper surface of the forward portion of the OK fuselage was provided for. The model was intended for the performance of research on aerodynamic heating, heat exchange and thermal protection of the orbital craft under conditions close to those of a flight on the atmospheric section.

The other—the Bor-5 (a 1:8 scale model of the OK) made a flight on a trajectory that ensured the realization of the essential criteria of similarity, and was intended for the performance of research on aerodynamic properties and heat exchange. The former was placed into the orbit of an artificial Earth satellite, and the latter into a suborbital trajectory.

A flight of the Bor-4 space plane was made for the first time on 4 Jun 82 with high aerodynamic quality on a route that covered several thousand kilometers. It was possible therein to ensure the precise arrival of the research craft at the assigned region of the Indian Ocean. It became possible, thanks to the its fitting with a control system able to perform navigational tasks, to accomplish movements both under space conditions and in flight in the atmosphere with reliable thermal protection. This flying model essentially differed from the physical craft only in dimensions, the lack of dedicated systems on board and reduced requirements for reliability and convenience of operation.

The brittle slabs for thermal protection supplied especially many concerns in the manufacture of the Bor-4. Even a light touching or bumping with the fingers against them left a dent, and they thus had to be replaced very often. A very senior staffer at the institute, I. Khanov, recalls that "Everything was finally ready, and the Bor-4 was mounted on the launch vehicle, which had already been fueled. The launch was to be at night—it was essential that the model land at dawn and that the maximum time remain to find and recover it. The reaching of the trajectory and its separation from the launch vehicle proceeded normally. Communications ceased, but it seemed to everyone that this had happened very early. Experienced testers reassured us—that is what always happens on high trajectories. It only remained to wait. But then came a report from testing supervisor V. Vladychin on the restoration of communications—the model had entered the atmosphere on trajectory, and all systems were on the norm. Now was the most crucial stage—prolonged flight in the atmosphere with reaching of the landing area. The communications were interrupted once again. Now the aircraft was in the plasma, and the situation was thus a tense one. The parachute system was finally actuated. The Bor-4 landed safely, or rather splashed down. The landing coordinates, however, diverged from the planned ones by 200 km! The controllers were confused. General G. Leksin, who had made contact with the control post, defusing the situation, asked, 'Please give me different landing coordinates, what, is that a problem?' But then a report came on the detection of the craft by the search ships, and everyone breathed easier."

The choice of a complex flight route for the craft was conditioned by three requirements: ensuring the maximum safety in the performance of the mission, the possibility of making a landing on water for the preservation of the thermal protection slabs and the receipt of the necessary information on the flight trajectory and the operation of the on-board systems. Later, after complete confidence in the operational reliability of the structure of the model and its system had appeared, the landing area would be shifted to the Black Sea.

A broad program of research on thermal and aerodynamic characteristics whose modeling would have been difficult or impossible under ground conditions was carried out in the process of the flight.

As for research on the aerodynamic heating and testing of the thermal protection of the OK, it was conducted on the Bor-4 at altitudes of 120 to 30 km at flight speeds of 7,500 to 1,200 meters/second. The model was put into a satellite orbit from the Kapustin Yar cosmodrome by maneuverable satellites of the Kosmos class (Nos. 1374, 1445, 1517 and 1614). The Bor-4 apparatus was the first domestic space plane able to maneuver in the atmosphere using the aerodynamic properties of the lifting body and having aerodynamic control surfaces.

The research that was conducted made a substantial contribution to working out the design of the thermal protection for the Buran OK, and made it possible to specify the maximum values for the temperature of various elements of its construction. The operability of a series of new thermal-protection materials and assemblies of carbon—carbon design, as well as the passability of radio waves through the plasma, was evaluated.

Flight research of aerodynamic characteristics and heat exchange was continued on the Bor-5 large-scale model. It was conducted in an unsettled flight mode in a speed range of 5,000 to 200 m/sec at altitudes of 120 to 10 km.

Dependences of the principal aerodynamic characteristics on the altitude and Mach number of the flight were obtained in the course of it (with high trustworthiness). The significant non-linearity of the dependence of the tracking moment on the glide angle was ascertained. All of this pointed to the necessity of certain changes in the aerodynamic configuration of the Buran OK, which were indeed made before its first flight.

The results obtained testify to the fact that a highly efficient scientific-research complex had been created in the country in the process of developing the orbital craft that could have been utilized successfully in the interests of the French Hermes project, the British Hotol and, especially, the NASP and Senger programs, the more so as the Europeans still do not have access to the information gathered by NASA during the flights of the space shuttle.

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